

Remarks

Examiner Venhl is thanked for the thorough Office Action.

IN THE CLAIMS

Parent Claim 1

Parent claim 1 step (c)(1) is amended. For support See spec. p. 7, L 11 to 25;
p. 8, L 22- 26.

Claim 19 step c is amended to state:

c) using an etch process to etch said organic low k dielectric layer through said opening to form a first opening using said masking pattern as an etch mask; said etch process does not comprise a plasma treatment; said etch process comprising:

(1) in a first step, etching said organic low k dielectric layer by applying a plasma power and flowing only NH₃ and N₂ etch gasses.

For support see specification p. 8 L 14-21, p. 12, L 8-14.

This amendment distinguishes the claim over cited reference Ngo.

Parent claim 27, step c is amended similarly to Claim 19, step c. See comments above.

CLAIM REJECTIONS:

Rejection Of Claims 1, 5, 6, 8 and 10 Under 35 U.S.C. § 103(a) as being anticipated by Ye et al. al. '529 in view of Yet et al. '516

The rejection of claims 1, 5, 6, 8 and 10 under 35 U.S.C. § 102(e) as being anticipated by Ye et al. '529 in view of Yet et al. '516 is acknowledged. Reconsideration and withdrawal of the rejection is respectfully requested in view of the following remarks .

Amended claim 1 is non-obvious

Amended claim 1 step c1 reads "in a first step, etching said organic low k dielectric layer by applying a plasma power and flowing gasses consisting of [at least] NH₃ gas, and [flowing] CO or O₂ [gasses] gas. "

The combination of Ye 529 and Ye 516 is improper. The references do not suggest they be combined. The references solve different problems.

Ye 529 and Ye 516 teach different and conflicting etch chemistries. Neither suggests they can be modified.

The Office Action dated, posits that Ye suggest this. However, Ye teaches away from the claim 1 step c1's NH_3 and CO or O_2 etch gas by teaching (1) (See Ye, col. 12, line 20-21) a O_2 and N_2 alpha FC layer etch. Secondly, Ye teaches (2) a (See Ye col. 22, lines 41-42,) a NH_3 only etch of FLARE TM low K layer. There is no suggestion to modify Ye's 2 separate etches/embodiments. Therefore Ye teaches away from amended claim 1 step C1.

The Office Action p. 3, cites Ye 516 as teaching claim 1's etch using NH_3 gas and CO or O_2 gasses. However, Ye 516 teaches a etch using " **O_2 , N_2 , NH_3 , Cl_2 , HCl or mixtures thereof by way of example and not by way of limitation**". See Ye 516 Col. 22, lines 14 – 16. Ye 516 does not teach the inventive concept of claim 1. Therefore it is not obvious for one skilled in the art achieve claim 1 from the over the thousandd different combinations possible from Ye 516. There is no motivation of achieve claim 1 because no reference attempts to solve the applicant's problem of bowing via sidewalls. See spec. p 1., line 17; spec p. 4, lines 21 -24.p. 8, Lines 23 -26.

Claims 5, 8 and 10 are non-obvious

Claims 5, 8 and 10 are non-obvious over the cited art because they depend from non-obvious amended claim 1.

Rejection of claim 4 Under 35 U.S.C. § 103(a)

The rejection of claim 4 Under 35 U.S.C. § 103(a) is acknowledged. Reconsideration and withdrawal of the rejection is respectfully requested in view of the following remarks .

Claim 4 states:

4. (Previously Amended) The method of claim 1 wherein said first step comprises applying a plasma power plasma density between $1\text{E}9$ and $1\text{E}11 \text{ cm}^{-3}$ and flowing NH_3 gas, a power in between 500 and 1500 W, and a NH_3 flow

1 between 50 and 300 sccm and a pressure between 80 and 800 mTorr and flowing
2 CO or O₂ gasses.
3

4 Dependant Claim 4 contains specific result dependent parameters for the
5 etch. These parameters are not suggested by the prior art. No other cited reference suggests that
6 adding CO or O₂ will reduce that polymer buildup and reduce sidewall bowing. See spec. p. 8,
7 section D. Also, Claim 4 specifies a “medium” “plasma power plasma power plasma density
8 between 1E9 and 1E11 cm⁻³ “ that is not suggested by the combination of references. See Spec.
9 p. 9 Section E.

10 The Office Action posits that Bhardwaj teaches that etch parameter can be
11 varied to change the etch rate. The Office Action further argues that one skilled in the art could
12 optimize the result depend variable to achieve claim 4.

13 However, no reference teaches the problem of the claim 1 and dependent
14 claims (4) solves, the bowed opening sidewalls. See spec. p 1., line 17; spec p. 4, lines 21 -24.p.
15 8, Lines 23 -26. Furthermore, no reference suggests the result dependent variables. Therefore
16 there is no way for one skilled in the art achieve claim 1 from the over thousand different
17 combination possible from Ye 516. There is no motivation of achieve claim 1 because no
18 reference attempts to solve the applicant’s problem of bowing via sidewalls. See spec. p 1., line
19 17; spec p. 4, lines 21 -24.p. 8, Lines 23 -26. Specifically, Claim 4 specifies a “medium plasma
20 power” that is not suggested by the combination of references. See Spec. p. 9 Section E.
21

22 **Rejection of claim 7 Under 35 U.S.C. § 103(a)**
23

24 The rejection of claim 7 Under 35 U.S.C. § 103(a) is acknowledged.
25 Reconsideration and withdrawal of the rejection is respectfully requested in view of the
26 following remarks .

27 Claim 7 depends from non-obvious parent claims as discussed above.

28 **Rejection of claim 9 Under 35 U.S.C. § 103(a)**
29

30 The rejection of claim 9 Under 35 U.S.C. § 103(a) is acknowledged.
31 Reconsideration and withdrawal of the rejection is respectfully requested in view of the
following remarks .

Amended claim 9 is non-obvious for the reasons discussed above for their respective parent claims. Moreover, claim 9 claim the exact process that create straight walled openings.

Rejection of claims 19, 22-24 and 25 under 35 U.S.C. § 103a as being unpatentable over Ye '529 and Ngo

The rejection of claims 19, 22-24 and 25 under 35 U.S.C. § 103a as being unpatentable over Ye and Ngo is acknowledged. Reconsideration and withdrawal of the rejection is respectfully requested in view of the remarks.

Parent claim 19 step c1, claims an etch with only NH₃ and N₂ etch gasses.

Amended Claim 19 reads:

19. A method of fabrication of etching a low -k dielectric layer; comprising the steps of:
a) forming an organic low k dielectric layer over a insulation layer over a substrate;
b) forming a masking pattern over said organic low k dielectric layer; said masking pattern having an opening;
c) using an etch process to etch said organic low k dielectric layer through said opening to form a first opening using said masking pattern as an etch mask; said etch process does not comprise a plasma treatment; said etch process comprising:

- (1) in a first step, etching said organic low k dielectric layer by applying a plasma power and flowing **only NH₃ and N₂ etch gasses**.

The combination of Ye et al. and Ngo et al. is improper.

The combination of Ye et al. and Ngo et al. is improper for the purpose cited in the Office Action because neither reference suggests they be combined and this can be only done by hindsight.

The office action dated 12/27/02, page 10, posits that the motivation to combine Ye and Ngo "comes from Ngo (paragraph 6) and that one skilled in the art would have found it obvious to combine Ngo into Ye method to produce the claimed invention." However, in the combination, Ngo is being used to show claim 19, step (c), a NH₃ and N₂ etch thru a low k layer.

1 In contrast to claim 19, Ngo, shows a “plasma treatment”, not “an etch”. A
2 close reading of Ngo col. 4, lines 40-42, shows that Ngo does not teach a etch step (of NH₃ and
3 N₂) but in contrast teaches a “plasma treatment”. See abstract. See col. 5, line 25, line 36- 48.
4 See figs 1 , 2 and 3. Ngo uses an unspecified chemistry to etch an opening. See Ngo, col. 5, lines
5 36 to 48.

6
7 The office action dated 12/27/02, page 6, posits that Ngo and Ye be combined
8 because Ngo’s treatment improves the quality of the low-k, citing Ngo col. 4, L 43-47

9 It was found that treatment of an organic carbon-containing low-k ILD in accordance with embodiments of
10 the present invention employing a plasma comprising nitrogen and a source of hydrogen, e.g., a NH₃/N₂ plasma, substantially prevents or significantly reduces degradation, such that the dielectric constant,
11 shrinkage and refractive index do not undergo a change in excess of 3%. It was also found that treatment of
12 dielectric materials, such as SiCOH, with the NH₃/N₂ plasma substantially prevented a reduction
13 in the number of Si-H bonds during subsequent processing.
14 Ngo col. 4, L 40-49.

15
16
17 However, claim 19 step c is an etch step to form an opening. The Ngo’s
18 plasma treatment to reduce low-k shrinkage is not an etch, nor does Ngo suggest that his plasma
19 treatment can be used as an etch.

20
21
22 **Even if combined Ye and Ngo do not meet claim 19, step c.**

23 Even if combined Ye and Ngo do not meet claim 19 step c1. Yu col. 22, lines
24 39 to 42 teaches a NH₃ only etch. This teaches away from claim 19’s only NH₃ and N₂ etch
25 gasses.

26 In contrast to amended claim 19’s “etch process to etch said organic low k
27 dielectric layer through said opening to form a first opening using said masking pattern as an
28 etch mask; Ngo col. 4, lines 40-42 does not form a first opening. In contrast, Ngo only performs
29 a “plasma treatment” See col. 4, lines 40 to 49; See col. 4, lines 5 -20. Ngo is a different step,
30 previous step, forms an opening. See Ngo col. 5, lines 37 – 40.

31 Therefore, it is improper to cite Ngo as an etch step. Furthermore, Ngo does
32 not met or suggest claim 19’s etch step or chemistry.

33 **Claims 22-24 and 25**

34 Claims 22-24 and 25 depend from non-obvious parent claim 19 are therefore
35 non-obvious.

Rejection of claims 20-21 under 35 U.S.C. § 103 as being unpatentable over Ye '529 and Ngo and Bhardwaj

The rejection of claims 20-21 is acknowledged. Claim 20 depends from non-obvious parent claim 19 as discussed above. Claim 20 claims non-obvious parameters. Claim 21 contains non-obvious parameters.

Claims 20-21 state:

20. (Amended) The method of claim 19 wherein said first step comprises:
power in between 500 and 1500 W, plasma power plasma density between 1E9 and 1E11 cm⁻³, a NH₃ flow between 50 and 300 sccm and a N₂ flow between 50 and 300 sccm and a pressure between 80 and 800 mTorr.

21. (Amended) The method of claim 19 wherein said first step comprises:
power in between 500 and 1500 W, plasma power plasma density between 1E9 and 1E11 cm⁻³, a NH₃ flow between 50 and 300 sccm and a N₂ flow between 50 and 300 sccm and a pressure between 80 and 800 mTorr and flowing CO or O₂ gasses.

Combination of Ye and Bhardwaj is improper.

The combination of Ye and Bhardwaj is improper. The combination of Ye and Bhardwaj can only be done by hindsight. There is no suggestion to combine the references. The references teach incompatible processes and teach away from each other. The point Bhardwaj is cited for, increasing the etch rate by varying every process parameter, is not related to the invention's object to increase the etch rate and straightness of the vertical walls of the opening. See spec. p. 12 lines 12 and claim 9.

Therefore, claims 20-21 are non-obvious.

Rejection of claim 26 under 35 U.S.C. § 103 as being unpatentable over Ye '529 and Ngo and McReynolds

Rejection of claim 26 is acknowledged. Reconsideration and withdrawal of the rejection is respectfully requested in view of the comments.

Claim 26 depends from a non-obvious parent claim and is non-obvious.

Furthermore, the combination of reference is improper because there is no motivation to combine them and they can only be combined by hindsight. Moreover,

McReynolds teaches a total unrelated etch process of different material, different gases and different results.

Rejection of claims 27 -29 under 35 U.S.C. § 103 as being unpatentable over Ye '529 and Ngo and Ye

The rejection of claims 27 -29 under 35 U.S.C. § 103 is acknowledged.
Reconsideration and withdrawal of the rejection is respectfully requested in view of the comments.

Parent claim 27 contains the limitations of parent claim 19 and is non-obvious for the reasons stated above.

Dependent claims 27 and 28 depend from non-obvious parent claim 27 and are therefore non-obvious. Claims 27 and 28 claim and etch with flowing NH_3 and N_2 etch gasses and flowing CO or O_2 gasses. These are non-obvious for the reasons stated above.

RESPONSE TO ADVISORY ACTION DATED 3/13/03

Claim 1

Regarding amended Claim 1, Claim 1 distinguishes over the cited references.

The advisory action argues that Ye's " **O_2 , N_2 , NH_3 , Cl_2 , HCl or mixtures thereof by way of example and not by way of limitation**" See Ye 516 Col. 22, lines 14 – 16. However, Ye 516 does not teach the limitations of claim 1. Therefore it is not obvious for one skilled in the art achieve claim 1 from the over thousand different combination possible from Ye 516. There is no motivation of achieve claim 1 because no reference attempts to solve the applicant's problem of bowing via sidewalls. See spec. p. 1, line 17; spec p. 4, lines 21 -24; p. 8, lines 23 -26. There is no motivation to select one of Ye 516's thousands of example gas combinations to meet claim 1 because Ye 516 give no guidance and does not attempt to solve the problem claim 1 solves.

Claim 4

Claim 4 claims a "medium" plasma power plasma density between $1\text{E}9$ and $1\text{E}11\text{ cm}^{-3}$. See Spec. p. 9, L1 to 11. This is non-obvious over the cited art for the reasons discussed above.

Claim 19

Claim 19 step c is amended to read “ using an etch process to etch said organic low k dielectric layer through said opening to form a first opening using said masking pattern as an etch mask; said etch process does not comprise a plasma treatment; “

This distinguishes over Ngo’s plasma treatment. Also, see arguments above. Ngo’s plasma treatment is not an etch. As described in Ngo, A plasma treatment does not form an opening. As used in the industry, a plasma treatment does not etch openings. Ngo’s does not meet claim 19, step c’s limitation to “using an etch process to etch said organic low k dielectric layer through said opening **to form a first opening**”.

ALLOWABLE SUBJECT MATTER

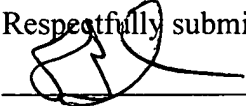
Applicant gratefully acknowledges the allowance of claims 11, and 13-18.

CONCLUSION

In conclusion, reconsideration and withdrawal of the rejections are respectfully requested. Allowance of all claims is requested. Issuance of the application is requested.

It is requested that the Examiner telephone the undersigned attorney or George Saile at (845) 452-5863 should there be anyway that we could help to place this Application in condition for Allowance.

Respectfully submitted,



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